The role of openBIM® in **better data exchange** for AEC project teams

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Introduction

The success of complex, multi-stakeholder Architecture, Engineering and Construction (AEC) projects relies on smooth collaboration and information sharing throughout the project lifecycle, often across different disciplines and software. The costs of inadequate interoperability to project teams, according to one analysis of capital facilities projects in the United States, approaches 17 billion annually, affecting all project stakeholders.[1] A more recent study by FMI and Autodesk's portfolio company Plangrid found that 52% of rework could be prevented by better data and communication, and that in an average week, construction employees spend 14 hours (around 35% of their time) looking for project data, dealing with rework and/or handling conflict resolution.[2]

In the AEC industry, many hands and many tools bring building and infrastructure projects to realisation. Across architects, engineers, contractors, fabricators and facility managers: inadequate interoperability leads to delays and rework, with ramifications that can reverberate throughout the entirety of the project lifecycle.

Over the last two decades, a strong point of alignment in the AEC industry has been in the development and adoption of the openBIM® collaborative process to improve interoperability and collaboration for building and infrastructure projects. In this white paper, Autodesk® provides a view on the development of openBIM as a neutral, non-proprietary process for improving collaboration within AEC project teams, centred on better data exchange through open data standards.

Project Data	File type
Architectural Model	RVT, RFA, SKP, 3ds
Structural Model	IFC, CIS/2, RVT
3D Printing	STL, OBJ
CAD Data	DXF, DWG, ACIS SAT
GIS Data	SHP, KMZ, WFS, GML
Civil Engineering	LandXML, DWG, DGN, CityGML
Cost Estimating	XLSX, ODBC
Visualisation Models	FBX, SKP, NWD, RVT
Handover to Facilities Management	COBie, IFC, XLSX
Scheduling Data	P3, MPP
Energy Analysis	IFC, gbXML
Scan to BIM	RCP, LAS
Site Imagery	JPG, PNG

Figure 1. On a single building project, many software applications and data formats may be required. The list shown here is an example and not intended to be comprehensive.

[1] Gallaher, Michael & O'Connor, Alan & Dettbarn, John & Gilday, Linda. (2004). Cost analysis of inadequate interoperability in the U.S. capital facilities industry. 10.6028/NIST.GCR.04-867

[2] Construction disconnected: The high cost of poor data and miscommunication [Report] Available at: <https://blog.plangrid.com/2018/08/fmi-plangrid-construction-report/

The challenge

‘What the industry needs is “big and open” BIM, which integrates the entire value chain and is characterised by full interoperability of software and open access to it.

The technical challenges are likely to be overcome in the near future, but it might prove more difficult to change existing processes and to increase collaboration, including data sharing’[3]

Shaping the future of construction
World Economic Forum (2018)

[3] World Economic Forum. Shaping the future of construction. www3.weforum.org. 2018. Available at: <http://www3.weforum.org/docs/WEF_Shaping_the_Future_of_Construction_full_report__.pdf

Key Terms and Classifications

Building Information Modelling (BIM)

BIM is the process of creating and managing information for a built asset. BIM provides a shared understanding of geometry and data to give all stakeholders working on an AEC project insight into the goals, plans and status for the project. The value of BIM is often seen in better handoffs between stakeholders, in improved communication between multi-disciplinary project teams, and in stronger alignment of design intent to project outcomes.

BIM is also the foundation of digital transformation for the AEC industry.

It has fundamentally changed the way project data is organised and how teams work together.

With BIM, multi-disciplinary project teams author and share intelligent 3D digital models and building information, leveraging the cloud to realise more timely and accurate data exchange.

Key Terms and Classifications

openBIM and buildingSMART

openBIM is a process centred on improving interoperability between software platforms. As the medium for data exchange in an openBIM process, Industry Foundation Classes (IFC) provide a neutral data exchange standard and intermediary file format to support the sharing of project data authored using different, often discipline-specific software. In this sense, IFC provides a common language for sharing project data, tied to the structuring and standards ratified by buildingSMART. The IFC data model contains both geometry and data properties for intelligent building elements, including the relationships between elements within a model. As an intermediary file format, IFC allows for the exchange and viewing of BIM, CAD and other file formats, a way of consuming and referencing the outputs of one collaborator to inform the work of another.

buildingSMART® openBIM®

With 25 chapters across Europe, Asia, the America, and Oceania, buildingSMART advances open data standards for the AEC industry locally and globally. BuildingSMART describes its engagement with the industry as working toward the 'full realisation of the societal, environmental and economic benefits of open sharable infrastructure and building asset information into commercial and institutional processes worldwide'. To accomplish this vision, buildingSMART convenes practitioners, industry groups, software vendors, governments and others around a core set of principles for openBIM:

1. **Interoperability** is key to the digital transformation in the built asset industry
2. **Open** and neutral standards should be developed to facilitate interoperability
3. **Reliable** data exchanges depend on independent quality benchmarks
4. **Collaboration** workflows are enhanced by open and agile data formats
5. **Flexibility** of choice of technology creates more value to all stakeholders
6. **Sustainability** is safeguarded by long-term interoperable data standards[4]

Autodesk has a long history with buildingSMART and an even longer history in promoting more open ways of working. In 1994, Autodesk was one of 12 software organisations to charter the Industry Alliance for Interoperability (IAI), which became the International Alliance for Interoperability in 1996.[2] The organisation renamed as buildingSMART in 2005.

[4] buildingSMART International. 2021. openBIM - buildingSMART International. [online] Available at: <https://www.buildingsmart.org/about/openbim/> [Accessed 19 February 2021].

Autodesk moves interoperability forward

1988

Autodesk develops DXF, an early open file format

1994

Co-founds International Alliance for Interoperability (IAI)

2002

Acquires Revit and begins developing the predecessor to IFC

2005

IAI becomes buildingSMART International, establishes Open BIM

2008

Autodesk and Bentley sign interoperability agreement

2010

Adds STL export in Revit and releases open-source STL plugin

2011

Makes Revit's import/export toolkit available as open source

2013

IFC4 is released and integrated into Revit

Integrates IFC standard into A360 and BIM360 cloud solutions

Revit adds CoBIE Extension

2016

Integrates IFC into Autodesk Inventor

Autodesk and Trimble sign interoperability agreement

Autodesk Navisworks adds CoBIE Extension

2020-2021

Autodesk and others pilot implementation of IFC4.3 for infrastructure workflows

2020

Autodesk joins Open Design Alliance; IFC4 certification for Revit in Architecture and Structure

Today

Autodesk Offers 14 software and collaborative platforms that support IFC

IFC 4: Expanding from Building Design to Infrastructure

Around the world, national BIM mandates are driving to prominence IFC as the preferred format for the handover of design deliverables, and as a way of ensuring owners can access and share their data without being tied to a single software vendor. To help meet this growing need, Autodesk is focused on improving the quality of its IFC data exchanges.

Autodesk's multidisciplinary BIM software **Revit** recently **obtained certification** for Industry Foundation Class 4 (IFC4) Reference Exchange for architecture and structure exports.

In addition, new pilots for infrastructure schema are in development, covering bridges, roads, railways as well as ports & waterways, and an international effort is under way to release the new IFC 4.3 schema for infrastructure in late 2021.

Other global efforts to support openBIM adoption include support of the U.S. General Services Administration (GSA) IFC model view, support for IFC Code-checking view certification by Building Construction Authority in Singapore, support and assistance in meeting UK BIM obligations for UK government clients, open-source software development kits for Revit provisioned by the Open Design Alliance, ODA and support for buildingSMART International as a member of the Strategic Advisory Council (SAC).

Autodesk is focused on improving the quality of its IFC data exchanges.

Table of Autodesk Products Supporting IFC

AutoCAD Architecture	AutoCAD MEP	Advance Steel	Civil 3D	Autodesk BIM Collaborate Pro (formerly BIM 360 Design)	Autodesk Docs	Fabrication CAD
Fabrication MEP	InfraWorks	Inventor	Navisworks	Revit	Revit LT	Robot Structural Analysis

Figure 2. Autodesk AEC products supporting IFC workflows.

openBIM and Beyond

To expand interoperability between AEC design software, IFC is essential in providing industry-vetted standards and methods for data sharing and exchange. Other essential ways of improving interoperability include cross-vendor data exchange agreements and partnerships. Autodesk has forged several such agreements with vendors and other ecosystem partners aimed at extending interoperability more broadly and with a common interest in customer success.

Agreements with Bentley®, Trimble®, ESRI®, Nvidia® and others are intended to improve interoperability across software platforms and industries.

Autodesk also supports other efforts to improve interoperability and data exchange initiatives including the U.S National BIM Standard (NBIMS), the Construction and Operations Building Information Exchange (COBie), and the National CAD Standard (NCS). These efforts collectively aim to improve the performance of new facilities by providing standards for data handover as projects move and change hands from design and development, through construction and into operation.

Several Autodesk BIM applications create and export COBie building handover information directly to a spreadsheet or via an IFC pathway, and can write CIS/2 data for structural steel collaboration, or to Standard ACIS Text (SAT) files for transporting geometry from one 3D application to another. Autodesk also supports a data exchange protocol for energy analysis, with sponsorship and support for the gbXML open schema.

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Conclusion

As AEC projects continue to grow in complexity, global teams author and exchange different types of data using a variety of software. Efficient, effective project collaboration and reliable data exchange are critical to success. IFC data exchanges play an important role in this environment, particularly where a native exchange does not exist. Autodesk's ongoing commitment to openBIM processes ensures AEC project teams can collaborate seamlessly by confidently leveraging shared data, while allowing all stakeholders the freedom to use the tools they want.

Want to learn more?

Discover open, collaborative and connected ways of working with Autodesk. Visit the BIM interoperability hub page to get the resources and tools you need to seamlessly connect your people and software.

Visit interoperability hub

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